Production of ^{252}Fm and ^{253}Fm in the ^{18}O + ^{238}U reaction

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^{253}Fm (t½ = 3.0 d, 6.943 MeV-α) as well as ^{252}Fm (t½ = 1.058 d, 7.039 MeV-α) were produced using the ^{238}U(^{18}O,3-4n) reaction to examine the usefulness of 3n- and 4n-exit channels from the fusion of actinide targets with heavy ion beams for the production of neutron-rich isotopes near the stable deformed shell at N=162, Z=108.

Reactions looking for 4n-exit channel products have been quite successful. However, the 3n-exit channel has only been observed with projectiles lighter then oxygen. ^{18}O beams were run at different energies in an attempt to search for a 3n-out product. A gold catcher foil caught the reaction products as they recoiled from the ^{238}U target. According to previous calculations [1], the collection efficiency of the catcher foil should be nearly 100%. After irradiating the uranium target for eight hours, the gold foil was processed chemically to purify the fermium fraction in the sample.

The gold catcher foil was dissolved in aqua regia and the resulting solution passed through an AG1-X8 anion exchange resin (200-400 mesh) column. The trivalent actinides passed through, while the gold, higher valent actinides and other reaction products remained on the column. The trivalent actinides were collected and dried on a platinum disk and counted with a silicon solid-state α-spectrometry system. In one experiment, the trivalent actinide fraction was sorbed on a Dowex 50-X4 cation exchange resin (200-400) mesh column and eluted with 0.5M α-hydroxyisobutyrate at a pH of 3.38 to separate the desired fermium fraction. The resulting fermium fraction was collected and dried on a platinum disk and counted with the α-spectrometry system.

Analysis of α-decay from these two experiments shows ^{252}Fm and possibly ^{253}Fm. After correcting for possible interference from ^{217}At (t½ = 32 ms, 7.067 MeV-α) which is present in the samples, production cross-sections of 7.9 ± 1.9 nb (at 83 MeV beam energy) and 69 ± 16 nb (at 87 MeV beam energy) were determined for ^{252}Fm. Because of interfering activity, primarily ^{252}Fm and a poor energy resolution, it was difficult to detect ^{253}Fm. The upper limits for the ^{253}Fm production cross-sections are 8.2 ± 1.9 nb (83 MeV) and 18 ± 5 nb (87 MeV). Previously reported values [2] are shown with the results in Figure 1.

Future work will continue to examine the 3n-exit channel using uranium targets and neon and heavier projectiles in the attempt to produce neutron-rich heavy element isotopes.

References

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2. E.D. Donets et al., Sov. J Nucl. Phys. **2**, 723 (1966).

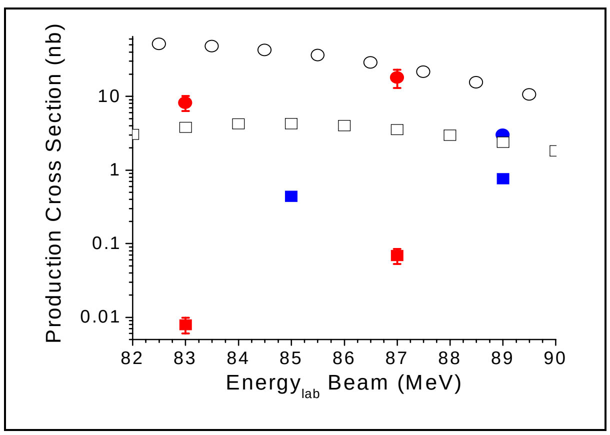

Fig. 1. Experimental production cross sections for the 3n- (squares) and 4n-exit channels (circles) are shown in red. Literature values are in blue and prediction codes in black.